

to the physical cause of the personality in question, viz. that in chronographic registration the tendency will be to press the key too late for faint stars, because their small neat disks make them appear further from the web than a bright star with its larger disk and rings at the same angular distance from the web.

I think it, therefore, not improbable that there may still remain systematic errors depending on magnitude in the right ascensions which have been deduced in the present discussion. The comparison with the heliometer measures will, however, probably settle the question.

The accompanying diagram shows the measures that have been made in the triangulation, and will enable the reader to form some idea of the geometrical conditions of rigidity which have been realised in the operation.

Another portion of the same plate shows similarly the measures from the stars to *Mars*.

A line thus ——— denotes both Morning and Evening Observations.

A line thus Evening Observations only.

A line thus - - - - - Morning Observations only.

On Observations of a Centauri made with the Heliometer at Ascension in 1877. By David Gill, Esq.

The following observations of the remarkable binary *a Centauri* were made during my stay at Ascension in the latter part of 1877. As I am frequently asked for the results of my measures of this object, I have thought it best to lay them before the Society without further delay.

The observations were not easy, as the following considerations will show.

The image of an infinitely distant luminous point is a disk surrounded by rings; the diameter of this disk varies inversely as the aperture of the telescope. For a telescope of 4 inches aperture (that of Lord Lindsay's heliometer) this disk has a diameter of about 1"; in other words, a telescope of 4 inches aperture will barely separate a double star whose distance is 1", the effect being to produce the appearance in fig. 1.

The half of a heliometer object-glass, however, produces a peculiar image of a single star, somewhat as in fig. 2.

Roughly speaking, it is an ellipse, whose axes are as 2 to 1, the smaller diameter being at right angles to the line of section of the object-glass, and the rings extending into a diffraction ray *ab*.

Now it happened that the first time I turned the heliometer upon *a Centauri* I found it, to all appearance, a single star rather ill defined, looking somewhat like a single star seen in a badly centred object-glass. The fact was, however, that the

heliometer happened to be set so that the position angle of the line of separation of the segments was nearly at right angles to the position angle of the star; the true effect was to produce the appearance shown in fig. 3, and the air being unsteady, the rings were mixed up with the disks in a puzzling way.

When, however, the position circle was set nearly to the true position angle of the stars, the effect became as in fig. 4, and in still moments the diffraction rings were well seen and also the fine diffraction lines ab , as in fig. 2.

It is evident that in such an image distances can be more accurately measured than position angles, and accordingly measures of the latter were made in greater number in order to give the results nearly equal accuracy with those from measures of distance.

In position-angle measures the observations were made as follows:—

In the field of view, and accurately adjusted to the plane of the principal focus of the objective, there was a square formed by fine flat gold wires cd and ef (fig. 5).

The wires ef were carefully adjusted to parallelism with the motion of the segments by setting the position circle to $90^\circ + \text{index correction}$, and allowing a star to run along the wires ef , or by placing a star on the edge of a wire and moving the segments rapidly to test if the star ran truly along its edge. This latter could be done almost independently of errors in the clockwork movement when the position circle was set to 90° .

This adjustment having been made, it was tested over and over again by both the methods described without my being able to improve it. I have therefore not attempted to apply any correction, and any error there may be in the coincidence of these wires with the motion of the segments is certainly very far within the accuracy

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

aimed at in the measure of position angle of so close a double star as α Centauri.

In making the measure of position angle the heliometer tube was turned in its cradle till the imaginary lines mn and m_1n_1 (fig. 5) seemed parallel with the lines ef . The imaginary lines mn , m_1n_1 are supposed to pass through the centres of the images formed by segment A and segment B of the object-glass respectively. The lines mn and m_1n_1 would of course coincide when parallel if the two segments could be adjusted so perfectly that their optical centres exactly coincided at least distance; that is to say, if the segments were so adjusted that the images of a single star produced by both segments could be exactly superposed by simple motion along the slides. Such an adjustment, even if once made, can never be long maintained, and during the observations at Ascension the error generally amounted to about $2''$. Thus the appearance of the stars when measured for position angle was nearly as shown in fig. 5. Of course the segments were reversed in each measure, and after each bisection the setting was displaced and brought up in alternate bisections from opposite directions.

By use of the reversing prism all the observations were made with the stars apparently either vertical or horizontal, and in each set of four bisections (constituting one measure) two bisections were made in each of two opposite directions of the image; that is, two bisections were made with the brighter star apparently to the right or above, and two bisections with the brighter star apparently to the left or below. No systematic difference was found between the position angles measured with the stars vertical and horizontal.

An observation for position angle having been made, the circle was set to the mean of the four readings which constituted the measure in position angle when the stars were arranged as in fig. 5. By careful movement of the slow motion handle, taking advantage of steady intervals of definition, the four diffraction lines were arranged at equal distance from each other and the scales were read off; the segments were then reversed, and the process was repeated. Now the little reversing prism was rotated 180° , the latter operation repeated, and finally the first operation was repeated. In this way the double distance of the stars was measured. When the observations were made in daylight, however, the diffraction lines ab could not be seen, and I then thought it more exact to measure the single distance, as in fig. 6, with similar precautions. After all the instrumental corrections have been applied, the following are the results:—

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Results of Measures of α_1 and α_2 Centauri at Ascension Island.

Date.	Distance.	No. of Obs.	Position Angle, °	No. of Obs.	Remarks.
1877·559	2·220	1			
·568	2·128	1	80 31	3	
·592	2·055	1	80 29	2	
·617	80 38	4	
·628	1·942	2	82 1	4	
·642	81 49	4	
·800	1·937	2	...		Measures made with great difficulty from unsteady air.
·827	1·863	1	99 41	2	
·841	1·760	3	94 36	3	
·876	1·806	1	99 54	2	
·901	1·438	1½	102 11	2	Definition very bad.

Thus, in hardly more than four months, we have evidence of a change of fully 0''·5 in distance and 20° in position angle. In connection with these measures, it is interesting to hear from Mr. Ellery (*The Observatory* for August 1868) that, from observations on May 8 of the present year, the components are now separating. Obviously, then, the above measures have been made during a critical and important epoch in the orbit. I only regret that much other work prevented my making more numerous measures, including some on artificial stars.

Additions to Memoir on the Theory of the Sidereal System.

By Maxwell Hall, Esq.

There are a few more stars to be added to the lists given in the Memoir on this subject, vol. xliii. of the *Memoirs*, and there are several Notes to be made respecting stars already discussed. These additions are for the most part satisfactory, and confirm the Theory as formerly explained.

It may be remembered that the Sun and the nearer stars were assumed to revolve in circular orbits about their common centre of gravity, a point in space whose position was found to be—

$$\left. \begin{array}{l} \text{R.A.} \quad 9 \quad 15 \\ \text{N.P.D.} \quad 63 \quad 28 \end{array} \right\} \begin{array}{l} 0 \\ 1850, \text{ Jan. } 10, \end{array}$$

and whose distance is 31 million times the distance of the Earth